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Original Article

Effects of Progressive Muscle Relaxation Training on Depression and Sleep in Fibromyalgic Patients

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ABSTRACT

Background: Fibromyalgia is a chronic multidimensional pain syndrome commonly associated with functional limitation, depressive symptoms, and disturbed sleep. Aerobic exercise is a core non-pharmacological intervention, but relaxation-based adjuncts may provide additional benefit by targeting muscular tension, autonomic arousal, and psychological distress. Objective: To compare the effects of progressive muscle relaxation combined with aerobic exercise versus aerobic exercise alone on fibromyalgia impact, depressive symptoms, and sleep quality in patients with fibromyalgia. Methods: This randomized controlled clinical intervention study enrolled 50 adults with fibromyalgia, mild depressive symptoms, and sleep disturbance from outpatient settings at Dow University of Health Sciences, Karachi. Participants were randomized to progressive muscle relaxation plus aerobic exercise or aerobic exercise alone. Thirty supervised sessions were completed over 8 weeks. FIQR and CES-D were assessed weekly, while PSQI was assessed at baseline, mid-intervention, and end intervention. Forty-two participants completed treatment and were included in the per-protocol analysis. Results: At week 8, the experimental group showed lower FIQR scores than the control group (44.70 ± 14.04 vs 56.47 ± 13.48, $p < 0.01$) and lower CES-D scores (31.45 ± 6.05 vs 37.68 ± 6.97, $p < 0.01$). End-intervention PSQI scores were also lower in the experimental group (13.10 ± 2.14 vs 14.77 ± 3.14, $p = 0.05$). Baseline-to-end reductions were greater in the experimental group for FIQR, CES-D, and PSQI. Conclusion: Progressive muscle relaxation combined with aerobic exercise produced greater short-term improvement in fibromyalgia impact, depressive symptoms, and sleep quality than aerobic exercise alone. Keywords: Fibromyalgia; Progressive Muscle Relaxation; Aerobic Exercise; Depression; Sleep Quality; Rehabilitation.

INTRODUCTION

Fibromyalgia is a chronic, multidimensional pain syndrome characterized by widespread musculoskeletal pain, fatigue, sleep disturbance, cognitive complaints, psychological distress, and impaired physical functioning. Although historically classified within rheumatological disorders, contemporary understanding recognizes fibromyalgia as a complex condition involving altered central pain processing, dysregulated neuroendocrine responses, impaired endogenous pain inhibition, and heightened sensitivity to sensory stimuli. The disorder substantially affects daily activity, social participation, emotional wellbeing, and health-related quality of life, particularly among clinically

referred patients who frequently present with overlapping symptoms of pain, fatigue, disturbed sleep, anxiety, and depressive features (1).

The clinical burden of fibromyalgia is amplified by the frequent coexistence of sleep disturbance and depressive symptoms. Poor sleep quality may intensify pain sensitivity, reduce coping capacity, and aggravate fatigue, while depressive symptoms may further impair motivation, physical activity tolerance, treatment adherence, and perceived quality of life. These interrelated symptoms create a reciprocal cycle in which pain, poor sleep, low mood, and functional limitation reinforce one another. Therefore, management strategies that target only pain may be insufficient, particularly in patients whose fibromyalgia presentation includes psychological and sleep-related components (2). A multidimensional therapeutic approach is consequently required, with emphasis on interventions that are safe, feasible, non-pharmacological, and capable of addressing both physical and psychosomatic symptom domains.

Exercise therapy, particularly aerobic exercise, is widely recommended as a core non-pharmacological intervention for fibromyalgia. Aerobic training may improve physical conditioning, reduce symptom severity, enhance fatigue tolerance, and contribute to better emotional wellbeing when appropriately prescribed and supervised. However, exercise alone may not adequately address stress-related arousal, depressive symptoms, and sleep dysregulation in all patients. Progressive muscle relaxation is a structured relaxation technique involving sequential contraction and relaxation of major muscle groups, usually combined with controlled breathing and focused awareness of bodily tension. Physiologically, progressive muscle relaxation may reduce sympathetic activation, promote parasympathetic regulation, decrease muscular tension, and support psychological calmness, thereby offering a plausible adjunctive role in fibromyalgia management (3).

Despite the theoretical and clinical relevance of combining relaxation-based therapy with aerobic exercise, evidence remains limited in local clinical settings regarding whether progressive muscle relaxation provides additional benefit beyond aerobic exercise alone for patients with fibromyalgia who also report depressive symptoms and disturbed sleep. In Pakistan, fibromyalgia is frequently encountered in clinical practice, but structured physiotherapy-led rehabilitation protocols remain underused, and locally generated randomized trial evidence is scarce. Furthermore, many patients are managed primarily through pharmacological approaches despite the need for safe, low-cost, non-pharmacological strategies that can be integrated into rehabilitation settings. This creates a practical and scientific gap: whether adding progressive muscle relaxation to an aerobic exercise program improves fibromyalgia impact, depressive symptoms, and sleep quality more effectively than aerobic exercise alone.

The present randomized controlled trial was therefore designed according to a comparative PICO framework in which the population comprised adults with fibromyalgia, mild depressive symptoms, and sleep disturbance; the intervention was progressive muscle relaxation combined with aerobic exercise; the comparator was aerobic exercise alone; and the outcomes were fibromyalgia impact, depressive symptoms, and sleep quality measured using the Revised Fibromyalgia Impact Questionnaire, Center for Epidemiological Studies Depression Scale, and Pittsburgh Sleep Quality Index. The objective of the study was to compare the effects of progressive muscle relaxation training combined with aerobic exercise versus aerobic exercise alone on fibromyalgia-related symptom impact, depressive symptoms, and sleep quality in patients with fibromyalgia. The study hypothesized that patients receiving progressive muscle relaxation in addition to aerobic exercise would demonstrate greater improvement in fibromyalgia impact, depression scores, and sleep quality than patients receiving aerobic exercise alone.

MATERIAL AND METHODS

This randomized controlled trial was conducted in the outpatient physiotherapy setting of the Institute of Physical Medicine and Rehabilitation and the psychiatry outpatient department at Ojha Campus, Dow University of Health Sciences, Karachi. The study enrolled adults diagnosed with fibromyalgia and associated mild depressive symptoms and sleep disturbance. Participants were recruited from clinical outpatient services after screening for eligibility, and written informed consent was obtained before enrollment. The study was conducted after approval from the Institutional Review Board of Dow University of Health Sciences under reference number IRB-451/DUHS/-14, dated May 6, 2014. The trial was originally planned as a 10-week intervention, but because of participant scheduling constraints and domestic limitations, the full 30 supervised treatment sessions were completed over an 8-week intervention period.

Eligible participants were male or female adults aged 18 to 50 years with widespread pain for at least three months, at least 11 positive tender points according to the American College of Rheumatology 1990 classification criteria, mild depressive symptoms based on DSM-IV criteria, and self-reported sleep disturbance. Participants were excluded if they had moderate or severe depressive disorder, primary sleep disorders such as hypersomnolence, narcolepsy, breathing-related sleep disorders, or parasomnias, acute traumatic injury limiting participation in physiotherapy, cardiovascular disease including angina, myocardial infarction, arrhythmia, or cardiomyopathy, pulmonary disease including tuberculosis, asthma, bronchitis, or chronic obstructive pulmonary disease, neurological disorders such as stroke, epilepsy, or multiple sclerosis, inflammatory rheumatic disease including systemic lupus erythematosus or rheumatoid arthritis, bleeding disorders, infectious disease, or pregnancy. These criteria were applied to ensure that participants had fibromyalgia-related symptoms appropriate for rehabilitation while reducing clinical confounding from disorders that could independently affect pain, fatigue, sleep, mood, or exercise tolerance.

A total of 50 eligible participants were enrolled and randomly allocated into two groups, with 25 participants assigned to the experimental group and 25 to the control group. Random allocation was performed using computer-generated simple randomization through Randomization Main software. Participants were assigned to intervention arms according to the generated randomization sequence after eligibility confirmation and consent. Eight participants discontinued treatment because of personal reasons, mainly transportation difficulties, lack of interest, and competing time commitments. Therefore, 42 participants completed the intervention and were included in the final analysis, comprising 20 participants in the experimental group and 22 participants in the control group. Because of the nature of the physiotherapy intervention, participants and the treating therapist could not be blinded to treatment allocation; however, the trial is best interpreted as a randomized controlled clinical intervention study with supervised group-based allocation.

The experimental group received a combined program of warm-up exercises, aerobic exercise, and progressive muscle relaxation. Each supervised treatment session lasted 50 minutes. The session began with 5 minutes of warm-up stretching, including upper back stretch, pectoralis stretch, and hamstring stretch, performed as three sets with a 15-second hold for each stretch. Aerobic exercise consisted of treadmill walking for 15 minutes and stationary cycling for 15 minutes. Progressive muscle relaxation was then performed for 10 minutes using sequential contraction and relaxation of major muscle groups in an ascending order from toes to head. The relaxation component emphasized whole-body contraction and relaxation with controlled breathing and guided awareness of muscular tension and release. The control group received aerobic exercise alone with the same aerobic dose, including 15 minutes of treadmill exercise and 15 minutes of stationary cycling, together with 10 minutes of warm-up and 10 minutes of cool-down exercises. Both groups were also advised a home exercise program consisting of 10 minutes of stretching exercises three times daily; however, the home program was unsupervised.

The primary clinical outcome was fibromyalgia-related symptom impact, measured using the Revised Fibromyalgia Impact Questionnaire. The FIQR assesses functional difficulty, overall impact, and symptom severity across domains relevant to fibromyalgia, with higher scores indicating greater disease impact. Depressive symptoms were assessed using the Center for Epidemiological Studies Depression Scale, a 20-item screening scale in which higher scores indicate greater depressive symptom burden. Sleep quality was assessed using the Pittsburgh Sleep Quality Index, which evaluates subjective sleep quality and related sleep components, with higher scores indicating poorer sleep quality. The questionnaires were translated into Urdu for participant comprehension. Educated participants completed the questionnaires independently, while participants unable to complete the forms themselves were assisted by the researcher through item-by-item reading and explanation without altering response choices. Baseline assessment was performed before the intervention. FIQR and CES-D were assessed repeatedly during the intervention according to the scheduled treatment assessments and summarized weekly across the 8-week intervention period, while PSQI was assessed at baseline, mid-intervention, and at the end of the intervention.

The independent grouping variable was treatment allocation, defined as progressive muscle relaxation combined with aerobic exercise versus aerobic exercise alone. The dependent outcome variables were FIQR score, CES-D score, and PSQI score. Additional baseline variables included age, sex, duration of fibromyalgia symptoms, and time since fibromyalgia diagnosis. Fibromyalgia was operationally defined according to the 1990 American College of Rheumatology criteria as widespread pain involving all four body quadrants for at least three months with at least 11 of 18 tender points on palpation. Mild depressive symptoms were identified according to DSM-IV criteria, and sleep disturbance was identified from participant history and PSQI assessment. Potential confounding was addressed at the design stage by applying exclusion criteria for major disorders that could independently affect pain, mood, sleep, or exercise performance; however, medication use was not monitored and should be recognized as a possible residual confounder.

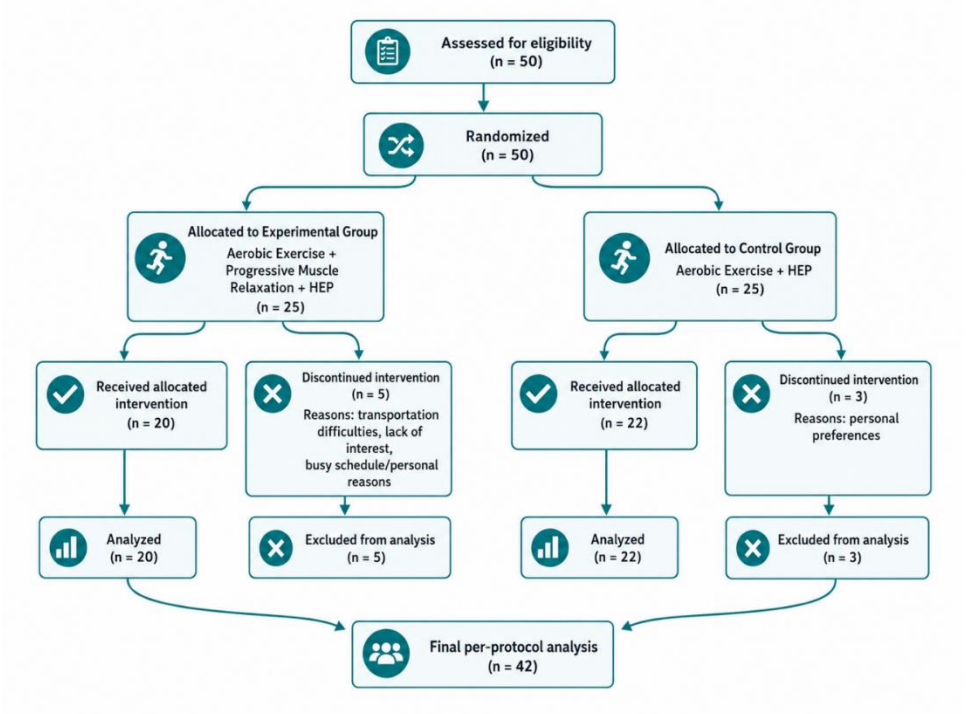

Figure 1 CONSORT Flowchart

The sample size was estimated using G*Power version 3.1.3. Based on the planned comparison and allowing for dropout, the initial calculated minimum sample was increased to 50 participants, with 25 participants allocated to each group. Data were entered and analyzed using IBM SPSS Statistics version 23. Continuous variables were summarized using mean and standard deviation, while categorical

variables were summarized using frequencies and percentages. Baseline demographic and clinical characteristics were described group-wise. Between-group comparisons of FIQR, CES-D, and PSQI scores were performed using independent-samples t-tests at the planned assessment points after evaluating normality assumptions. Within-group changes over time were assessed using repeated-measures general linear modeling. Statistical significance was set at $p < 0.05$. Because only participants who completed treatment were analyzed, the findings represent a per-protocol analysis rather than a full intention-to-treat analysis. Data were checked for completeness, consistency, and entry accuracy before analysis to support data integrity and reproducibility.

RESULTS

A total of 50 participants were randomized, with 25 participants allocated to the experimental group and 25 to the control group. Eight participants discontinued the intervention because of personal reasons, mainly transportation difficulties, lack of interest, and competing time commitments. The final per-protocol analysis included 42 participants, comprising 20 participants in the experimental group and 22 participants in the control group.

Table 1. Baseline Demographic and Clinical Characteristics of Participants Included in the Final Analysis

Variable	Control Group (n = 22)	Experimental Group (n = 20)
Male, n (%)	1 (4.5)	3 (15.0)
Female, n (%)	21 (95.5)	17 (85.0)
Age 18–28 years, n (%)	2 (9.1)	1 (5.0)
Age 29–38 years, n (%)	7 (31.8)	6 (30.0)
Age 39–50 years, n (%)	13 (59.1)	13 (65.0)
Age, Mean ± SD	40.09 ± 7.43	41.15 ± 7.52
Fibromyalgia duration, Mean ± SD	4.73 ± 2.14	5.70 ± 2.77
Time since fibromyalgia diagnosis, Mean ± SD	2.59 ± 1.79	1.90 ± 1.07

The analyzed sample was predominantly female in both groups, with 21 of 22 participants in the control group and 17 of 20 participants in the experimental group being women. Most participants were aged 39–50 years, including 13 participants in each group. Mean age was similar between the control and experimental groups, while the experimental group had a slightly longer mean duration of fibromyalgia symptoms and a shorter mean time since diagnosis. These values describe the enrolled clinical sample and should not be interpreted as population prevalence estimates.

FIQR scores declined progressively in both groups, with increasing separation between the groups over time. At week 1, scores were nearly identical between the control and experimental groups, with a mean difference of 0.12 and Cohen's d of 0.01. By week 7, the experimental group showed lower FIQR scores than the control group, with a mean difference of -10.63, 95% CI -19.25 to -2.01, and Cohen's d of -0.77. At week 8, the difference further increased to -11.77, 95% CI -20.37 to -3.17, with Cohen's d of -0.86, indicating a larger between-group separation at the end of intervention.

Table 2. Between-Group Comparison of Revised Fibromyalgia Impact Questionnaire Scores Across the Intervention Period

Assessment Point	Control Group Mean ± SD	Experimental Group Mean ± SD	Mean Difference	95% CI	Cohen's d	p-value
Week 1	80.23 ± 10.11	80.35 ± 9.74	0.12	-6.07 to 6.31	0.01	0.97
Week 2	77.56 ± 10.59	76.34 ± 8.73	-1.22	-7.25 to 4.81	-0.13	0.68
Week 3	74.18 ± 11.27	69.92 ± 10.90	-4.26	-11.18 to 2.66	-0.38	0.22
Week 4	69.72 ± 12.97	64.08 ± 13.15	-5.64	-13.80 to 2.52	-0.43	0.17
Week 5	66.13 ± 13.60	59.21 ± 13.52	-6.92	-15.39 to 1.55	-0.51	0.10
Week 6	62.42 ± 13.44	54.71 ± 13.23	-7.71	-16.03 to 0.61	-0.58	0.06
Week 7	60.25 ± 14.08	49.62 ± 13.55	-10.63	-19.25 to -2.01	-0.77	0.02
Week 8	56.47 ± 13.48	44.70 ± 14.04	-11.77	-20.37 to -3.17	-0.86	<0.01

Footnotes: Mean difference was calculated as experimental group minus control group. Negative values indicate lower FIQR scores in the experimental group.

CES-D scores decreased over the intervention period in both groups. During the first four weeks, the experimental group had numerically higher mean CES-D scores than the control group, with week 1 showing a mean difference of 2.11 and week 4 showing a mean difference of 2.42. From week 5 onward,

the direction of difference shifted toward lower CES-D scores in the experimental group. At week 8, the experimental group had a lower mean CES-D score than the control group, with a mean difference of -6.23, 95% CI -10.29 to -2.17, and Cohen's d of -0.95.

Table 3. Between-Group Comparison of Center for Epidemiological Studies Depression Scale Scores Across the Intervention Period

Assessment Point	Control Group Mean ± SD	Experimental Group Mean ± SD	Mean Difference	95% CI	Cohen's d	p-value
Week 1	53.09 ± 4.10	55.20 ± 3.07	2.11	-0.14 to 4.36	0.58	0.06
Week 2	53.27 ± 3.52	54.40 ± 3.56	1.13	-1.08 to 3.34	0.32	0.30
Week 3	50.77 ± 4.84	52.50 ± 4.35	1.73	-1.14 to 4.60	0.37	0.23
Week 4	48.68 ± 5.79	51.10 ± 5.03	2.42	-0.96 to 5.80	0.44	0.15
Week 5	47.36 ± 10.63	46.40 ± 6.36	-0.96	-6.37 to 4.45	-0.11	0.72
Week 6	43.27 ± 7.09	40.60 ± 7.87	-2.67	-7.36 to 2.02	-0.36	0.25
Week 7	39.59 ± 6.72	36.20 ± 6.21	-3.39	-7.42 to 0.64	-0.52	0.09
Week 8	37.68 ± 6.97	31.45 ± 6.05	-6.23	-10.29 to -2.17	-0.95	<0.01

Footnotes: Mean difference was calculated as experimental group minus control group. Negative values indicate lower CES-D scores in the experimental group. Confidence intervals and Cohen's d were derived from the reported group means, standard deviations, and final analyzed sample sizes. p-values are based on independent-samples t-test comparisons.

Table 4. Between-Group Comparison of Pittsburgh Sleep Quality Index Scores Across the Intervention Period

Assessment Point	Control Group Mean ± SD	Experimental Group Mean ± SD	Mean Difference	95% CI	Cohen's d	p-value
Baseline	19.54 ± 2.89	19.90 ± 2.88	0.36	-1.44 to 2.16	0.12	0.69
Mid-intervention	17.40 ± 3.12	17.05 ± 2.28	-0.35	-2.04 to 1.34	-0.13	0.67
End intervention	14.77 ± 3.14	13.10 ± 2.14	-1.67	-3.33 to -0.01	-0.62	0.05

Footnotes: Mean difference was calculated as experimental group minus control group. Negative values indicate lower PSQI scores in the experimental group. Confidence intervals and Cohen's d were derived from the reported group means, standard deviations, and final analyzed sample sizes. p-values are based on independent-samples t-test comparisons.

PSQI scores decreased from baseline to the end of intervention in both groups. At baseline, the mean difference between groups was 0.36, with a 95% CI from -1.44 to 2.16 and Cohen's d of 0.12. At mid-intervention, the mean difference was -0.35, with a 95% CI from -2.04 to 1.34 and Cohen's d of -0.13. At the end of intervention, the experimental group had a lower PSQI score than the control group, with a mean difference of -1.67, 95% CI -3.33 to -0.01, and Cohen's d of -0.62.

Table 5. Baseline-to-End Mean Change in Primary and Secondary Outcomes

Outcome	Control Group Baseline	Control Group End	Control Group Mean Change	Experimental Group Baseline	Experimental Group End	Experimental Group Mean Change	Between-Group Difference in Mean Change
FIQR	80.23	56.47	-23.76	80.35	44.70	-35.65	-11.89
CES-D	53.09	37.68	-15.41	55.20	31.45	-23.75	-8.34
PSQI	19.54	14.77	-4.77	19.90	13.10	-6.80	-2.03

Footnotes: Mean change was calculated as end score minus baseline score. Negative values indicate reduction in symptom burden. Confidence intervals and p-values for change scores were not calculated because the standard deviations of within-person change and baseline–follow-up correlations were not reported.

The magnitude of mean reduction was greater in the experimental group across all measured outcomes. FIQR decreased by -35.65 points in the experimental group and -23.76 points in the control group, producing a between-group difference in mean change of -11.89. CES-D decreased by -23.75 points in the experimental group and -15.41 points in the control group, producing a between-group difference in mean change of -8.34. PSQI decreased by -6.80 points in the experimental group and -4.77 points in the control group, producing a between-group difference in mean change of -2.03.

Overall, the results show progressive improvement in fibromyalgia impact, depressive symptoms, and sleep quality in both intervention arms, with greater end-intervention improvement in the group receiving progressive muscle relaxation combined with aerobic exercise. The clearest between-group separation was observed at week 8 for FIQR and CES-D, while PSQI showed a smaller end-intervention difference. Because the final analysis included only participants who completed treatment, these findings should be interpreted as per-protocol results.

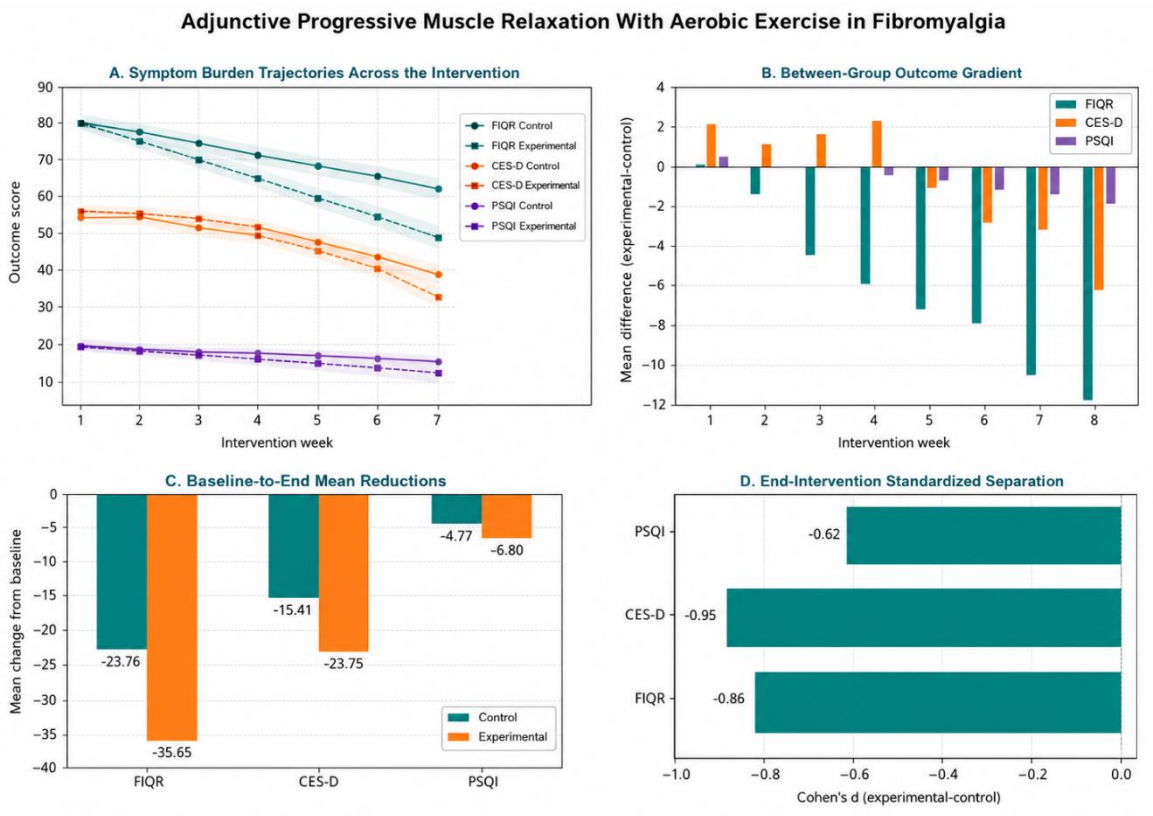

Figure 2 illustrates the comparative response pattern across fibromyalgia impact, depressive symptoms, and sleep quality during the intervention period. FIQR and CES-D trajectories showed progressive reductions in both groups, with increasing separation favoring the experimental group after mid-intervention and the largest end-point differences at week 8. Baseline-to-end reductions were greater in the experimental group for FIQR (-35.65 vs -23.76), CES-D (-23.75 vs -15.41), and PSQI (-6.80 vs -4.77). End-intervention standardized differences also favored the experimental group, with Cohen's d values of -0.86 for FIQR, -0.95 for CES-D, and -0.62 for PSQI, indicating the strongest separation for depressive symptoms and fibromyalgia impact, followed by sleep quality. Lower scores indicate lower symptom burden across all three outcomes.

DISCUSSION

This randomized controlled clinical intervention study showed that both aerobic exercise alone and aerobic exercise combined with progressive muscle relaxation were associated with reductions in fibromyalgia impact, depressive symptoms, and poor sleep quality over the 8-week intervention period. However, the addition of progressive muscle relaxation produced greater end-intervention improvement across all measured outcomes. The clearest between-group separation was observed for fibromyalgia impact and depressive symptoms, with week 8 FIQR scores of 44.70 ± 14.04 in the experimental group compared with 56.47 ± 13.48 in the control group, and CES-D scores of 31.45 ± 6.05 compared with 37.68 ± 6.97, respectively. Sleep quality also improved in both groups, with end-intervention PSQI scores of 13.10 ± 2.14 in the experimental group and 14.77 ± 3.14 in the control group. These findings suggest that progressive muscle relaxation may provide clinically useful adjunctive benefit when incorporated into an aerobic exercise-based rehabilitation program for patients with fibromyalgia, mild depressive symptoms, and sleep disturbance.

The improvement in FIQR scores in both groups supports the role of aerobic exercise as a core non-pharmacological intervention in fibromyalgia management. Exercise has been recommended in several evidence-based approaches because it may improve physical conditioning, fatigue tolerance, functional capacity, and symptom perception in patients with fibromyalgia. In the present study, the control group demonstrated a baseline-to-end FIQR reduction of 23.76 points, indicating that aerobic exercise alone contributed to meaningful symptom improvement. However, the experimental group demonstrated a larger FIQR reduction of 35.65 points, suggesting that the combined intervention may have addressed additional symptom mechanisms beyond physical conditioning alone. Fibromyalgia is not only a pain

disorder but a multidimensional condition involving altered pain modulation, fatigue, emotional distress, and sleep dysregulation; therefore, combining exercise with relaxation training may be more appropriate than relying on a unimodal rehabilitation approach (4,5).

The greater reduction in depressive symptom scores in the experimental group is clinically important because depression and fibromyalgia frequently coexist and may amplify disability, pain perception, sleep disruption, and poor treatment adherence. In the early intervention period, CES-D scores were slightly higher in the experimental group, but by week 8 the direction of difference had reversed, with a larger reduction in depressive symptoms among participants receiving progressive muscle relaxation. This pattern supports the possibility that relaxation-based training may require repeated practice before measurable psychological benefit becomes evident. Progressive muscle relaxation involves sequential contraction and relaxation of major muscle groups, controlled breathing, and awareness of muscular tension, which may reduce sympathetic arousal and promote psychological calmness. These mechanisms are relevant to fibromyalgia because stress-related autonomic dysregulation and heightened somatic vigilance may contribute to symptom persistence (6,7).

Sleep quality improved in both groups, with a greater baseline-to-end reduction in PSQI scores in the experimental group than in the control group. The between-group difference for PSQI was smaller than that observed for FIQR and CES-D, but the direction of effect was consistent with the broader outcome pattern. Sleep disturbance is a common and clinically relevant component of fibromyalgia and may contribute to pain amplification, fatigue, reduced coping capacity, and impaired daytime functioning. The observed improvement in sleep quality may be explained partly by the effects of aerobic exercise and partly by the downregulation of physical and psychological tension through relaxation practice. However, because PSQI was assessed only at baseline, mid-intervention, and end-intervention, the temporal pattern of sleep improvement cannot be interpreted with the same precision as the weekly FIQR and CES-D trajectories.

The demographic pattern of the analyzed sample showed that most participants were female and most were aged 39–50 years. This finding is consistent with clinical literature reporting a higher proportion of women among diagnosed fibromyalgia samples, but it should not be interpreted as a population prevalence estimate because the study used clinical outpatient recruitment rather than community-based sampling. Similarly, the age distribution reflects the enrolled sample and cannot determine age-specific disease frequency. The study therefore contributes clinical intervention evidence rather than epidemiological evidence.

The findings should be interpreted in light of several methodological limitations. First, the final analysis included 42 participants rather than the 50 randomized participants, and the analysis was per-protocol because only participants who completed the intervention were analyzed. This may overestimate treatment effects if participants who discontinued differed systematically from those who completed treatment. Second, allocation concealment and assessor blinding were not reported in sufficient detail, which may increase risk of selection or assessment bias. Third, the intervention was supervised in the clinical setting, but the home exercise program was unsupervised, making adherence outside the treatment sessions uncertain. Fourth, medication use was not monitored, although analgesics, antidepressants, or sleep-related medications could influence pain, mood, and sleep outcomes. Fifth, the Urdu-translated questionnaires were used to improve participant comprehension, but formal validation of these translated versions was not reported, which may affect measurement reliability. Finally, the study did not include post-intervention follow-up, so durability of treatment effects after supervised rehabilitation remains unknown.

Despite these limitations, the study has several strengths. It used a randomized comparative design, clinically relevant eligibility criteria, supervised intervention delivery, and multidimensional outcome assessment using FIQR, CES-D, and PSQI. The inclusion of fibromyalgia impact, depressive symptoms, and sleep quality provides a broader evaluation of patient-centered outcomes than pain alone. The

consistent direction of benefit across all three outcomes supports the potential value of integrating progressive muscle relaxation into physiotherapy-led fibromyalgia rehabilitation. Future trials should use updated diagnostic criteria, preregistered protocols, concealed allocation, blinded outcome assessment, intention-to-treat analysis, medication monitoring, validated local-language instruments, and longer follow-up to determine whether the observed benefits are sustained and generalizable across broader clinical settings.

CONCLUSION

Progressive muscle relaxation combined with aerobic exercise produced greater short-term improvement in fibromyalgia impact, depressive symptoms, and sleep quality than aerobic exercise alone among patients with fibromyalgia who completed the intervention. The findings support the adjunctive use of progressive muscle relaxation as part of a multidimensional physiotherapy rehabilitation program, particularly for patients presenting with psychological distress and disturbed sleep in addition to fibromyalgia-related functional impairment. Because the analysis was per-protocol and the study had limitations related to sample size, missing-data handling, questionnaire validation, medication monitoring, and absence of long-term follow-up, the results should be interpreted as promising preliminary clinical evidence rather than definitive proof of sustained effectiveness.

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